Ice-binding proteins for cryopreservation of heart cells and tissue

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The high global prevalence of heart failure creates an urgent need for donor hearts. Currently 70% of the available donor hearts cannot be used for transplantation,[1] due to the limited preservation time of 4-6 hours in conventional cold storage.[2] Long-term storage in a frozen state (cryopreservation) would provide a solution, but the formation of ice crystals in the tissue results in irreparable freezing damage. The use of ice-binding proteins is a promising strategy to protect the organ.[3,4] Natural ice-binding proteins from cold-adapted organisms modulate the size and shape of ice crystals, but they are not evolved for cryopreservation. In our research we will characterize the activity of both natural ice-binding proteins[5] and modified versions, to elucidate how the protein structure induces the different forms of ice-binding activity: ice recrystallization inhibition,[6] crystal shaping, thermal hysteresis[4] and ice nucleation.[7] Ultimately, we will apply this knowledge to engineer novel ice-binding proteins that are optimized to protect heart cells and tissue against freezing damage.

Acknowledgements:

Roderick Tas, Tim Hogervorst, Marco Hendrix, Ilja Voets (Self-Organizing Soft Matter – Eindhoven University)
Carlijn Bouten, Atze van der Pol (Soft Tissue Engineering and Mechanobiology – Eindhoven University)
Vasco Sampaio Pinto, Linda van Laake (Cardiology – Utrecht University Medical Center)
European Research Council

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